

# Soil susceptibility to wind erosion drives the abundance of microplastics in remote Scottish soils

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## INTRODUCTION

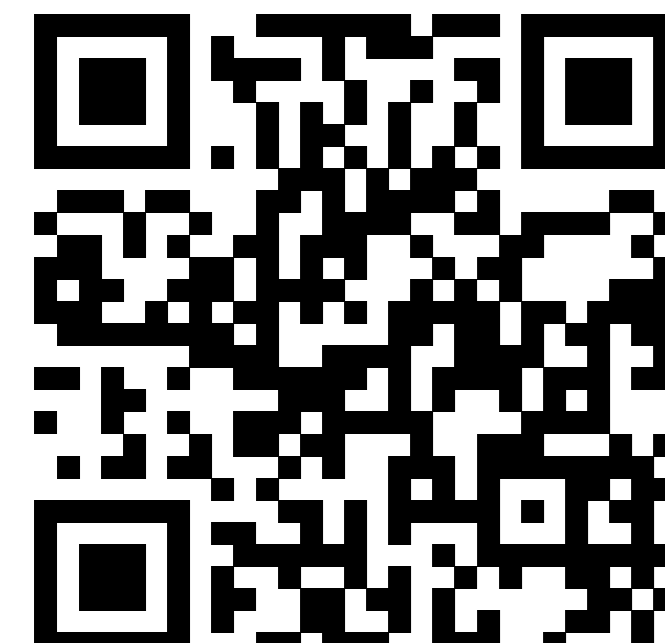
Microplastics (MPs) are plastic particles smaller than 5 mm. They have been found in various environments, including Mariana Trench and the Himalayas. MPs are present in water, air, and also in soil. High concentrations were found in soils in Beijing, China (22,001 MPs/kg)<sup>1</sup>, Lower Rhine region, Germany (25,502–51,119 MPs/kg)<sup>2</sup> or Coimbra, Portugal (106,000 MPs/kg)<sup>3</sup>. All these places are densely populated, but there are also less populated and less influenced locations in the world, including the **Outer Hebrides**, Scotland.

Let's find out:

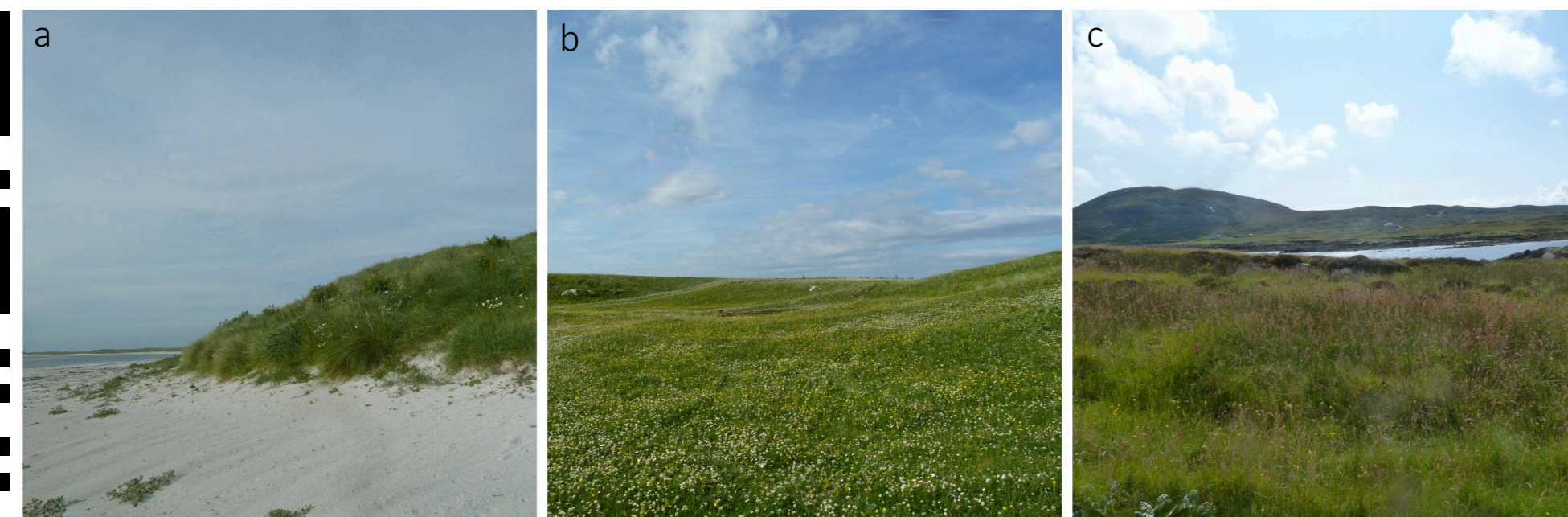
- How many MPs are in the remote Hebridean soils?
- Does the remoteness guarantee smaller MP pollution?
- And what influences the distribution of MPs in the Outer Hebrides?

## STUDY AREA

Outer Hebrides are an archipelago in the Sea of the Hebrides located west of the Scottish mainland. The abundance and distribution of MPs in soils were studied in the **Isle of South Uist**. This island has sandy beaches in the west (picture a), machair is east from them (picture b), and the inland is covered with peatlands and moorlands (picture c). There are several west–east gradients of environmental variables:



Scan to see where are the Outer Hebrides



### SANDY BEACH

sand texture  
 sparse vegetation  
 almost no roots  
 mostly sand cliff

### MACHAIR

sandy loam  
 denser vegetation  
 more roots  
 undulating plain

### INLAND

loam & peat  
 dense vegetation  
 dense roots  
 more rugged terrain

## METHODS



### Sampling

123 samples in four W–E transects and along the west coast were sampled of approx. volume of 100 ml.



### Wrapping

Soil samples were wrapped into an aluminium foil and cotton bag to prevent secondary plastic pollution.



### Weighing

All samples were transferred into Petri dishes, weighed, and dried.



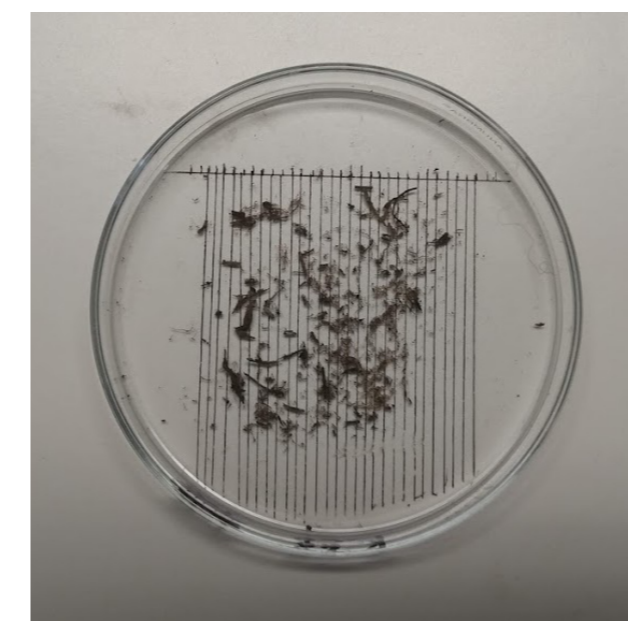
### Heating method

Heating method by Zhang et al. (2018)<sup>4</sup> was examined, but did not work, not even for new plastics.



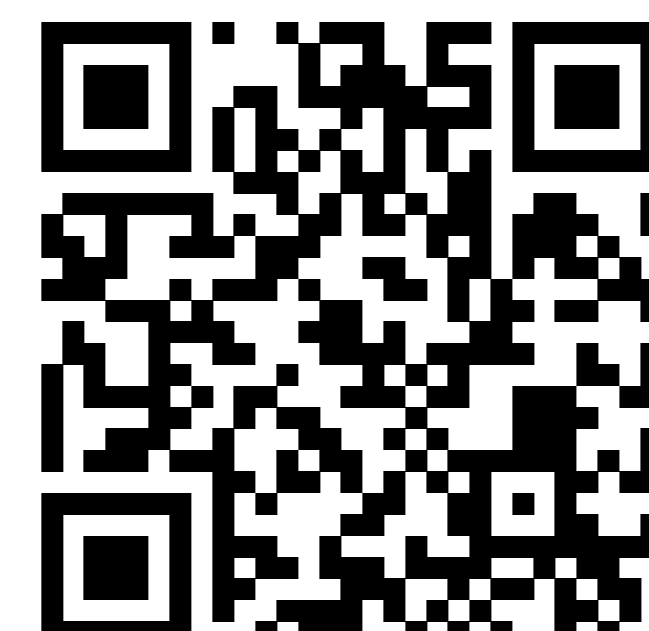
### Density separation

A mixture of ethanol and water separated low-density MPs (and organic matter...).



### Lined Petri dish

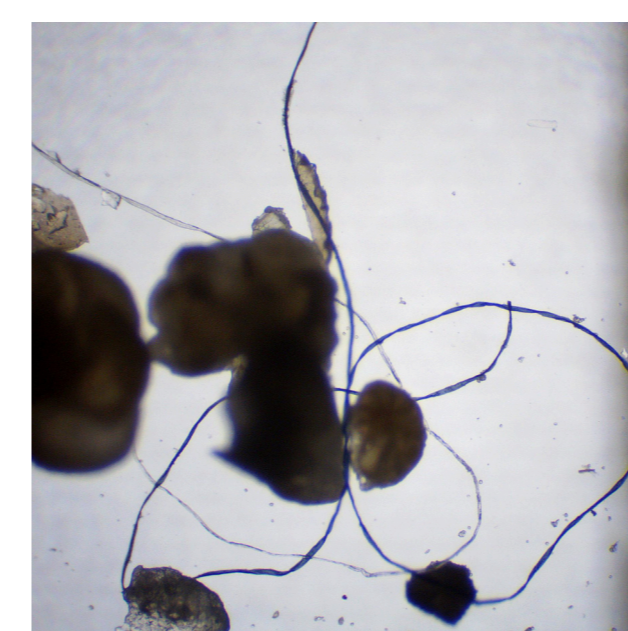
Floating material (a subsample) was put into a lined Petri dish to help navigate while microscoping.



Scan to see what else I could find!

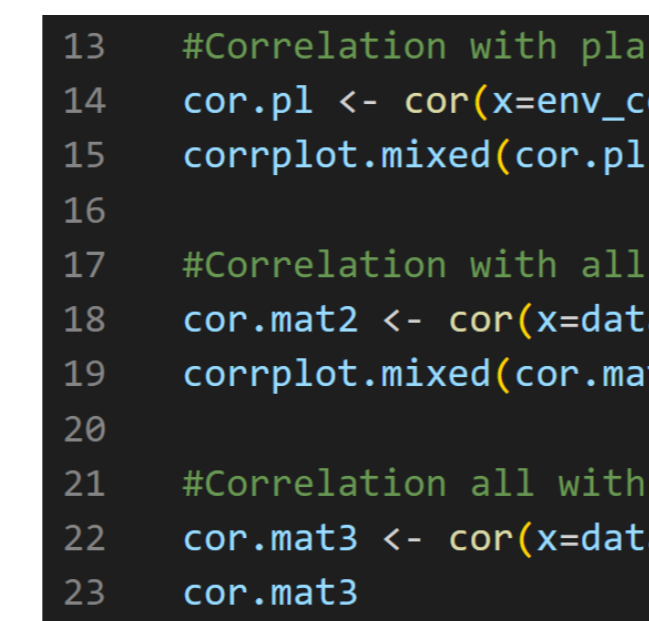
### Microscoping

Samples were recorded using an optical microscope.



### Quantification

Only plastic microfibrils could be identified, and were quantified manually and by software.



### Statistics

Basic statistics such as mean, median, or correlations were calculated.



### Spatial modelling

MP abundance for the Outer Hebrides was modelled using Boosted Regression Trees.

## RESULTS

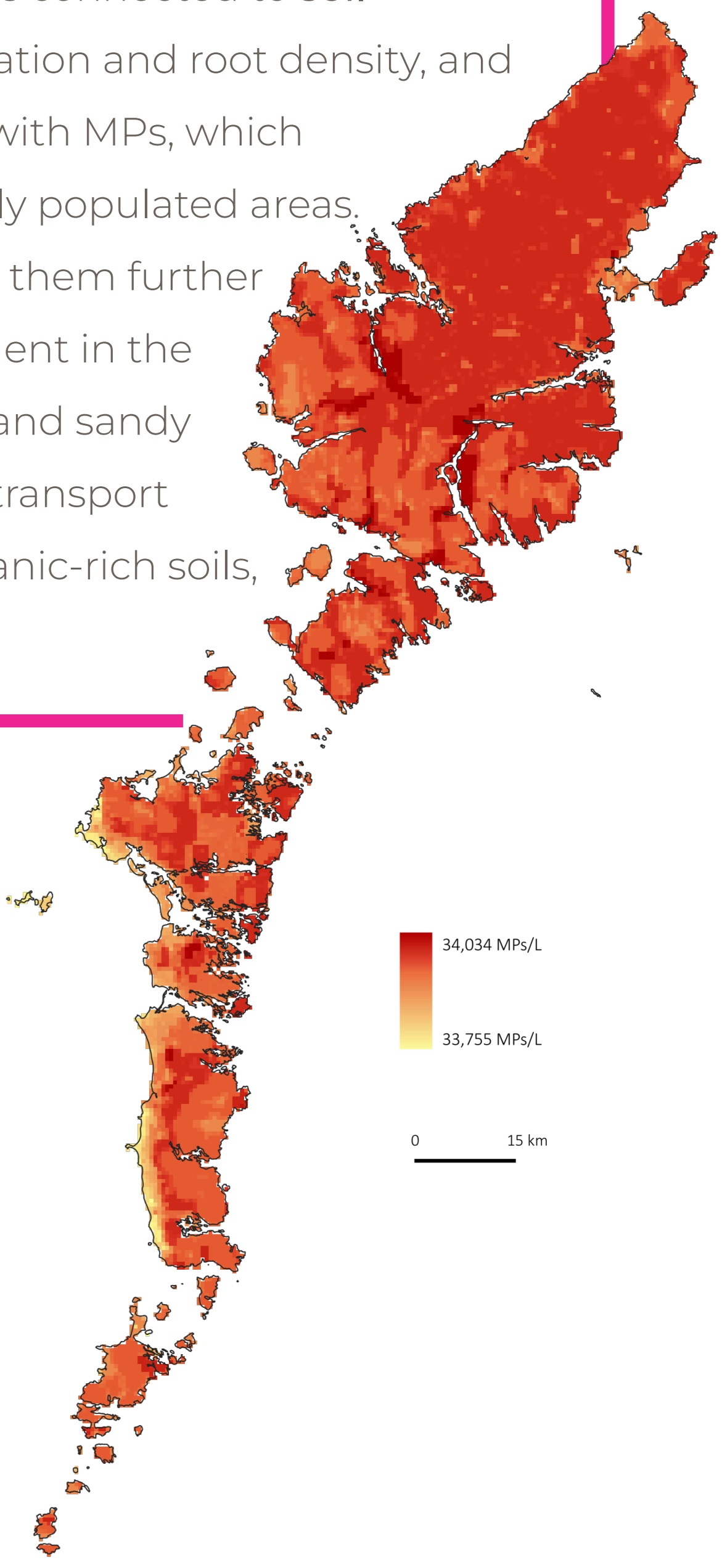
Far more MPs were found in the inland than in the coastal soils. The abundance of MPs is another W–E gradient, driven not by the distance from the ocean but by the environmental characteristics connected to **soil susceptibility to wind erosion** – soil texture, vegetation and root density, and wetness. The ocean continually supplies the land with MPs, which substitutes a direct human origin of MPs in densely populated areas. Once the MPs are on a beach, the wind transports them further inland from easily erodible sand. Some MPs sediment in the machair soils, but the medium-dense vegetation and sandy loam soil enable the wind to deflate the MPs and transport them even further, where they accumulate in organic-rich soils, which are less susceptible to wind erosion.

**36,900**

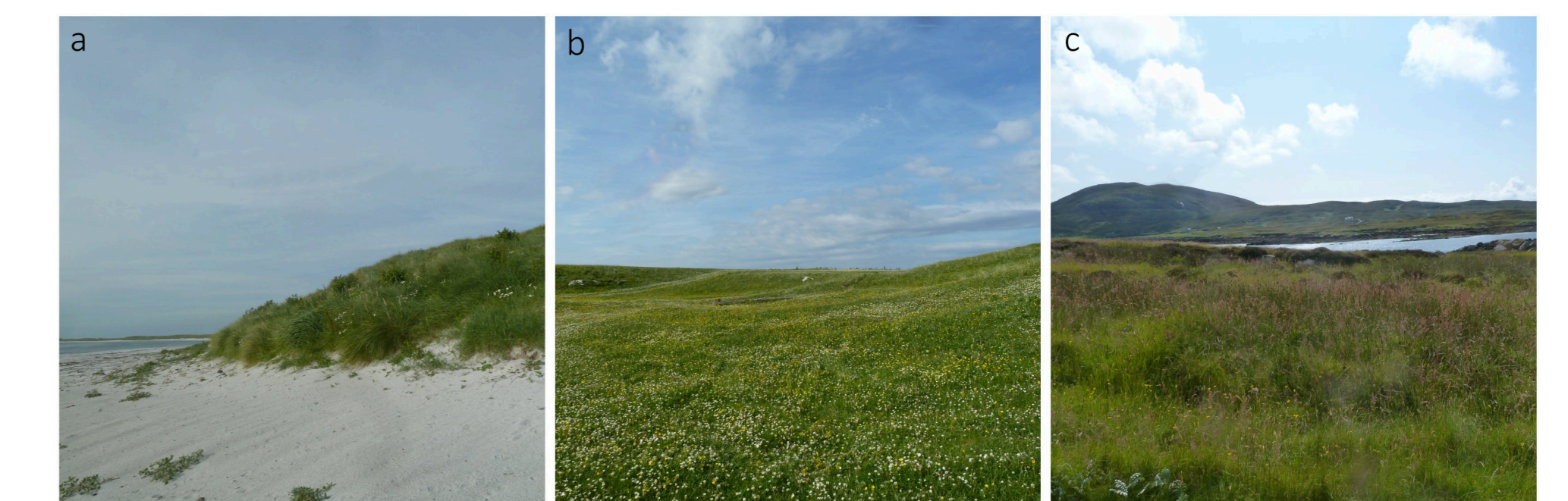
plastic microfibrils per litre of inland soil\*

**3,580**

plastic microfibrils per litre of coastal soil\*



### WIND TRANSPORT FROM THE OCEAN



### SANDY BEACH

deflation

### MACHAIR

deflation  
 accumulation

### INLAND

accumulation



References:  
 1 Zhang et al. (2022): <https://doi.org/10.1016/j.envpol.2022.119121>  
 2 Rolf et al. (2022): <https://doi.org/10.1016/j.scitotenv.2022.155141>  
 3 Leitão et al. (2023): <https://doi.org/10.1016/j.envres.2022.114961>  
 4 Zhang et al. (2018): <https://doi.org/10.1016/j.scitotenv.2017.10.213>

\*median

